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Flexible Behälter

Réipients flexibles

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**EP-A- 0 183 573**  
**US-A- 4 781 472**

**EP-A- 0 288 079**

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**EP 0 535 869 B1**

## Description

The present invention relates to a liner for a flexible container and a container incorporating a liner, particularly but not exclusively for transport and storage of bulk material, especially pulverized or granular material.

Flexible containers for bulk materials, so called FIBC's, normally comprise an outer container bag with lifting loops and a filling opening.

For most users of such flexible containers it is necessary that the material to be transported is protected against being contaminated by dust, water, etc., and this is usually achieved by the use of an impervious liner made from plastic sheet material, paper or suchlike which is positioned within the outer container, usually against the inner wall thereof, the liner being filled with the material to be transported and/or stored.

It has been found desirable to position the liner in its load-carrying outer container at the production site of the container and one way of making such a composite container is to fasten the liner to the material forming the outer container, part way through the assembly of the container, with glue or tape, thereafter finishing the sewing of the outer container.

However it has proved to be difficult to place the liner in the outer container in such a way that it is neither damaged, nor crumpled and adopts a form which matches that of the outer container. Otherwise the liner becomes prone to bursting when filled with bulk material. Furthermore, displacement and unfastening of the liner may occur during use and obviously placing the liner correctly during bag manufacture does not help if it is displaced before or during the filling operation.

One method of aligning the liner in the outer container has been proposed by the Applicants in European Patent 0141429 in which the container is placed inside a folding means in the form of a tunnel or open ended box having a square cross-section, the liner thereafter being placed inside the finished outer container and then inflated. The longitudinal side walls of the box are divided and joined together, for example, by hinges. Subsequent to inflation the box is pressed together and during this operation the hinged side walls form gussets in both the liner and the outer container. The container and liner are pressed together and can then be drawn out of the box and, optionally can also be folded crosswise of the longitudinal direction, and are then ready for transport to the filling site for bulk material.

Due to the open nature of the woven cloth making up the outer container, all superfluous air between the outer container and the inner liner will be squeezed out so that in the final flattened form no air is present between the liner and the outer container thus avoiding difficulties at later filling stages and ensuring that the liner and the outer bag are in correct alignment.

This method while providing a correct, smooth and crease free fit between the inner liner and the outer bag does, however, require an extra manufacturing step at the bag production site. Furthermore, the method does

not solve a further problem caused by air remaining inside the inflated liner that is entrapped by the granular, particulate bulk material during filling of the bags. Such remaining air inside the liner bag after the bag is filled may constitute as much as up to 10 to 15% of the total volume of the bulk material, when the filling spout of the liner is sealed, which is desirable to obtain maximum protection. The trapped air will only leak out gradually over time and causes considerable problems in connection with the subsequent handling, transport and storage of the filled bags.

When the filled sacks are handled and stacked, the contents settle and compact allowing the trapped air to form a deformable cushion within the sack. This can cause the sack to adopt a rounded shape, affecting the stability of a stack of the sacks and making it difficult to handle the filled sacks mechanically. Furthermore, the trapped air will expand or contract with variations in the surrounding temperature, causing the air cushion to swell and deflate. In an extreme case, this can cause the wall of the sack to rupture where excess expansion of the air cushion takes place.

U.S. specification No. 4,781,472 shows a bag having a complementary liner therein and means for suspending the liner from the container, however no vents are provided in the liner.

It is an object of the present invention to provide a liner which may properly and efficiently be located in the outer container and to alleviate the above mentioned air entrapment problems.

A liner in accordance with the invention for use with a tougher outer container is made of flexible plastic material and comprises at least one suspension means for connecting the liner to an outer container in a predetermined orientation characterised in that the suspension means forms a vent for the expellation of air from the liner.

The liner which is preformed may be folded into a substantially air-free configuration and then secured within the outer container each suspension means of the liner being connected to an upper part of the container.

The liner is preferably designed to be of such a size relative to the container in which it is to be placed that on connection with the suspension means to the container, the liner, on filling, conforms to the internal dimensions of the container.

Preferably each suspension means is formed as a tubular strip of the material of the liner.

When a bag with the liner has been filled, the spout inlet is closed but air within the liner may be vented through the tubular suspension means and/or through one or more vents or vent holes in a wall of the tubular suspension means and/or in the wall of the liner. In order to prevent ingress of moisture a one-way valve means is preferably provided to control flow of air/water through the vents and/or vent holes.

The one-way valve means may be provided by the action of the opposite walls of the liner which seal against each other, this one-way valve being especially efficient

when the vents are provided in a tubular suspension means.

Additionally, and particularly if the vent holes are formed near an upper corner of the containers, the flow of air through the vent holes may be controlled by a one-way valve comprising a "labyrinth" seal.

An alternative form of the invention consists of a container and a liner as defined in claim 14.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows, schematically, one embodiment of a liner in accordance with the invention.

Fig. 2 is an end view, after transverse folding, of the liner of Fig. 1.

Fig. 3 is a view of the liner shown in Fig. 2 after longitudinal folding.

Fig. 4 is a view of a composite container (FIBC) with an inner bag or liner similar to that shown in Figs. 1-3 mounted in position and ready for filling.

Fig. 5 is a sectional view taken on Line V-V of Fig. 4. Figure 6 is a diagram showing a liner similar to that shown in Figs 1-3 but having a labyrinth seal providing a one-way valve controlling vent holes in the suspension means.

Figs. 7-10 are diagrams showing alternative versions of a labyrinth seal to control vent holes provided in the liner.

Fig. 11 is a diagram illustrating a liner or bag provided with a filling spout and with air vents controlled by a labyrinth seal and

Fig. 12 is a diagrammatic view of the top end of a liner similar to that illustrated in Figs. 1-3 to illustrate the use of an appropriate welding tool.

Referring to Figures 1-3, a liner 100 is formed from two sheets of impervious, flexible material, preferably plastics, which are joined together by an end welded seam 102 and side welded seams 104, 106 to form a bag which is open at one end and which has regions 110, 112 removed therefrom at that end to form a castellated end shape. Further seams or welds 116, 118 are then formed at the periphery of each region 110, 112 to define three essentially tubular members 120, 122 and 124. The tubular member 120 provides a filling spout for the liner bag while tubular sections 122 and 124, form suspension means for connecting the liner to an outer container. The suspension tubes 122, 124 further provide an "air release" function as will be described hereinafter.

After manufacture the liner bag 100 is folded to form a compact package 130 (See Fig. 3) from which most air has been expelled. To accomplish this, the liner 100 is folded on longitudinal folding lines L1, L2, L3 and L4 illustrated by dotted lines in Fig. 1 to form a compact shape as shown in plan in Fig. 2. The liner is then folded out of the plane of the paper along folding lines L5, L6 and L7 (See Fig. 3) in sequence to arrive at the completely folded package 130 as shown in the top part of Fig. 3.

An adhesive tape 132 is used to hold the liner in a folded position.

The folded liner is then attached within and orientated relative to, an outer container bag 140 as is illustrated schematically in Figs. 4 and 5.

The outer container 140 which is for example made from woven polypropylene, is shown in a "ready for use" condition having front and rear sides 142, 144 and two internal folds or gussets 146, 148. The outer container is provided with an integral lifting strap formed in a top section by folding and sewing in the conventional manner. The lifting strap may be of a single point or multiple point construction. Also, the bottom of the outer container may be of the form as shown which unfolds to form a rectangular bottom or may be a star or double square bottom.

The folded liner 130 is stowed between sides 142, 144 and between the gussets 146, 148. The liner is attached to the outer container by means of the suspension tubes 122, 124 which are provided with fastening means (not shown) and are disposed in line and flush with the upper edge 150 of the container 140 and connected to diagonally opposite corners of the sides 142, 144 as shown in Fig. 4.

In use, when it is desired to fill the container, filling apparatus having a filling tube (not shown) is inserted in the filling spout 120 of the liner, the liner bag 100 is inflated against the outer bag 140 and the liner unfolds and expands against the outer bag without creasing. The liner only then being filled with bulk or granular material. Alternatively, the bulk material may be filled directly into the compacted liner 130, which expands during filling. The only air which is allowed to enter the liner is then the air remaining in the bulk material itself.

After filling the spout 120 is closed or sealed.

The tubular suspension means 122, 124 provide a further function of one way valve means allowing air remaining in the bulk material to escape. The one way valve action is provided by the portions of the sheets of flexible material forming the sides of each tube which generally lie in contact one with the other but which part in response to positive pressure within the liner to allow air to be expelled. This expellation of air may be assisted by vent holes or openings 152 provided in the sides of the tubular sections. When the air has exited from the liner, the sides of the suspension tubes 122, 124 seal together to close the tubes and the openings 152 to prevent entry of air or water.

The material of the liner may be made of mono extruded polyethylene, 80/100 microns thick. Alternatively, it is envisaged that the liners can be made of a thicker multi-layer polypropylene material, say, from 80-85 microns, the different layers having different properties, e.g. the outer layers being strong but permeable and the inner layer being impermeable and having good welding characteristics. It is desirable for the liner material to have properties of strength, puncture resistance and permeability but this is not easily obtainable in a sin-

gle layer construction. Alternatively, laminated container materials may be employed.

The embodiments of the invention described are not to be construed as limitative. For example, instead of two suspension means 122, 124, a single suspension tube or three or more suspension tubes may be used. Furthermore the form and size of the filling spout or spouts may be changed according to requirements as may be the size and placement of the openings 152. Alternatively, the openings 152 may be removed completely.

Furthermore, although the liner has been shown formed from two pieces of material, the liner may equally be formed from a piece of tubular material in which case the side seams 104, 106 are unnecessary.

The liner can also be an integral part of the container, whereby the alternative venting with the special labyrinth vents is used according to the invention. Especially when venting containers of small size, these may initially be made from impervious materials, so that only the venting problems remain to be solved.

Advantages which are provided by a liner bag of the present invention are:

1. The liner will have a correct position in relation to the outer bag when the liner is inflated.
2. The liner will retain its correct position in relation to the outer bag during transport and handling of the empty bags as well as during filling and emptying of the bag. Neither will the liner be displaced if water accidentally penetrates into the bag.
3. The additional blow-folding step during production is eliminated resulting in a manufacturing saving operation.
4. There is substantially no air within the empty liner, which might otherwise have caused problems during baling/palletting of the empty bags for transport to packaging sites, i.e. there is no risk of bursting of the liners when the bales or pallets are compressed. The palletted units are also more stable (not subject to displacement).
5. Due to the pressure of exhaust valves in the liner superfluous air in the bag after filling is able to evacuate so that the formation of "air balloon" above the bulk material after the bag has been filled and the liner has been closed or sealed. This avoids the risk of the liner bursting when the bags are stacked on top of each other in a number of layers.

In the alternative shown in Figure 6, the vent/seal combination is formed in the side pieces 122 and 124 by punching two vent holes 152 and 154, typically about 5 mm diameter in the upper and lower portions of the side pieces approximately as shown, and forming two interrupted line seals 156 and 158 across the foot of each side piece as shown. The gaps in the line seals and the spacing between the line seals are shown in detail in Figure 7, which relates to a bag with integral liner.

The vent holes 152 may be provided by forming one or more apertures in the wall of the container as illus-

trated for example by cutting a slit in the wall or punching a circular or other shaped hole in the wall material. If desired, the wall material can be only partially cut away to form a flap which overlies the aperture and assists in preventing ingress of water or moisture into the sack. Typically, the aperture has a plan area of less than 3 to 15 square mms and has a maximum dimension of less than 10 mms. Conveniently, approximately 5 - 7.5 mms diameter circular vent holes are used. Preferably, one of the vent holes is formed axially lower in the liner wall so that water which enters the dead space through the upper hole can drain out through the lower hole rather than penetrating the seal to enter the body of the sack.

A labyrinth seal may be used to valve the vents each seal being formed as line heat seals between opposed walls or seals of the container, for example by applying a heat sealer bar to the sack during its manufacture or by applying adhesive between the appropriate areas of opposed walls of the sack. The seals may be simple straight line seals or may be of more complex shapes. Thus, the seals can be curved or can be of dogleg or waveform shape. For simplicity, the invention will be described hereinafter in terms of a simple straight line seal.

The labyrinth is formed by overlapping at least two of the line seals for part of their length, e.g. for from 10 to 50% of their length. If desired, more than two seals can be used so that there is multiple overlap to give a more tortuous path between the interior of the sack and the vent. Alternatively, one line seal can be interrupted to form two or more axially aligned portions each separated by an axial gap; and a second seal or line of seals formed which overlaps the gap(s). Preferably the line of seals extends to the outer edge of the container. The path between the seals typically has a maximum cross-sectional area of less than 0.5 to 5 square mms. Preferably, the seals are spaced less than 20 mm, for example from 5 to 10 mms apart so that particles of the granular material cannot readily escape from the sack via the seals and so that the path will tend to self seal when the bag is flexed during handling and there is a tendency to draw air into the sack through the vent. Where an interrupted line seal is used to provide axial gaps in a line seal, the gaps typically extend for from 10 to 50% of the adjacent sealed portion of the line. Thus a gap can be from 10 to 15 mms long with the sealed portions each being from 25 to 50 mms long.

The line seals 156, 158 shown are interrupted to form two parallel series of short seals 160a, 160b, 160c etc. and 162a, 162b, 162c etc with axial gaps 164 and 166 between the short seals. The seals 160 and 162 overlap each other by approximately 20 to 30% at each end and the gaps 164 and 166 between the short seals are typically 10 to 15 mms and the line seals are spaced 10 to 30 mms apart. This forms a dead space 168 outside the seals and two circular vent holes 152 and 154 are punched through the liner wall in this dead space.

The labyrinth seals may be arranged as shown in Figure 8, especially if the vents are located in the upper

corners of a liner or bag in a construction having only a central filling spout as shown in diagrammatic form in Fig. 11. Alternatively the seals may be employed with a liner bag having vented or tubular suspension means.

Alternatively, the seal 12 can be provided by curved line seals 20 as shown in Figure 9 or wave or saw tooth form seals 21 as shown in Figure 10. In the latter case the seals can be in or out of phase so as to enable a fine path to be formed without the need for extreme accuracy in placing the seals.

When the liner is to be manufactured in different sizes it has been found that the U-shaped cut-outs 110,112 between the central filling spout 120 and the suspension means 122,124 may be maintained constant. This enables a welding tool having single sized U-shaped inner parts 170 (See Fig. 12) to be employed.

When the outer edge 172 of the suspension means 122,124 is substantially aligned with the corresponding side seams 174 of the liner bag then there is no need for there to be a separate weld along the outer edge of the suspension means since this is already sealed during the formation of the bag.

If, however, the bag width is wider so that the side edge 174 of the liner bag is a significant distance away from the side edge 172 of the suspension means 122, 124 (which means are fairly narrow so as to function properly as a vent e.g. from 40-80 mm), then it is necessary to weld the material of the bag along the curved line 176.

To this end the part of the welding tool illustrated in Figure 12 is used to form the inner edge 172 and the curved line 176 may be used only when desired. When it is not desired, this part is left cold but is heated when welding is desired. Thus liner bags having a width of between 1270 and 2030 mm can be produced using the same tool.

#### Claims

1. A liner (100) of plastic material for a container (140) such as a flexible intermediate bulk container, the liner comprising at least one suspension means (122,124) for connecting the liner to the container in a predetermined orientation, characterised in that the suspension means (122,124) form a vent for expellation of air from the liner.
2. A liner as claimed in Claim 1 wherein the or each suspension means (122,124) is formed integrally with the liner.
3. A liner as claimed in Claim 1 or 2 wherein the or each suspension means (122,124) is formed as a tubular strip of material.
4. A liner as claimed in Claim 3 wherein one or more vent openings (152) are provided in a wall of the hollow flexible strip.
5. A liner as claimed in any one of the preceding claims wherein, prior to filling, the liner has a substantially air-free configuration.
6. A liner as claimed in Claim 5 wherein the liner is folded to form a substantially air-free package, the package being ready for connection to a container.
7. A liner as claimed in any one of the preceding claims wherein the or each suspension means (122,124) is provided with fastening means for connecting the liner to a flexible container.
8. A liner as claimed in any one of the preceding claims wherein a one-way valve device is provided for the vent or vents.
9. A liner as claimed in any of the preceding Claims having one or more vent openings (152,154) either in a hollow suspension means (122,124) and/or in a corner adjacent the suspension means, flow of air through the openings being controlled by a one-way valve device.
10. A liner as claimed in Claims 8 or 9 in which the one-way valve device is provided by the walls of the hollow suspension means (122,124).
11. A liner as claimed in either Claim 8 or 9 wherein the or each vent and/or vent opening is controlled by a "labyrinth" seal device, comprising seal lines (156,158; 160,162) overlapping to form a labyrinth path.
12. A container having a liner as claimed in any one of the preceding claims connected thereto.
13. A container as claimed in Claim 12 wherein the liner is of such size and shape and the suspension means are connected to the container in such an orientation that the liner, on filling, conforms to the internal dimensions of the container.
14. A container having an inlet at one end thereof, and a liner therein characterised in that at least one vent opening is provided in the liner at or adjacent the inlet end and having at least two elongated interrupted, adjacent seals (156,158; 160,162) between the opposed walls of the liner, adjacent the or each vent on that side which in use is filled with bulk material, the seals overlapping axially with one another to provide a labyrinth path between the interior of the liner and the vent(s).

#### Patentansprüche

1. Einlage (100) aus einem Plastikwerkstoff für einen Behälter(140), wie etwa ein biegsamer Zwischenbehälter für loses Gut, wobei die Einlage wenigstens

ein Aufhängungsmittel (122, 124) zum Verbinden der Einlage mit dem Behälter in einer vorher bestimmten Ausrichtung aufweist, dadurch gekennzeichnet, daß die Aufhängungsmittel (122, 124) eine 5 Entlüftung zur Austreibung der Luft aus der Einlage bilden.

2. Einlage wie in Patentanspruch 1 beansprucht, in welcher ein Aufhängungsmittel oder jedes Aufhängungsmittel (122, 124) eine Einheit mit der Einlage bildet. 10
3. Einlage wie in Patentanspruch 1 oder 2 beansprucht, in welcher das oder jedes Aufhängungsmittel (122, 124) als ein schlauchförmiger Streifen des Materials geformt ist. 15
4. Einlage wie unter Patentanspruch 3 beansprucht, in welcher eine Entlüftungsöffnung (152) oder mehrere davon in einer Wand des hohlen flexiblen Streifens angeordnet wird bzw. werden. 20
5. Einlage wie in jedem der vorangegangenen Patentansprüche beansprucht, in welcher vor dem Füllen die Einlage eine im wesentlichen luftfreie Konfiguration aufweist. 25
6. Einlage wie in Patentanspruch 5 beansprucht, in welcher die Einlage gefaltet ist, um ein im wesentlichen luftfreies Paket zu bilden, wobei das Paket fertig ist zur Verbindung mit dem Behälter. 30
7. Einlage wie in jedem der vorangegangenen Patentansprüche beansprucht, in welcher das oder jedes Aufhängungsmittel (122, 124) ausgestattet ist mit Befestigungsmöglichkeiten um die Einlage mit einem flexiblen Behälter zu verbinden. 35
8. Einlage wie in jedem der vorangegangenen Patentansprüche beansprucht, in welcher ein Einwegventilgerät für die Entlüftung oder die Entlüftungen vorgesehen ist. 40
9. Einlage wie in einigen der vorangegangenen Patentansprüche beansprucht, die eine Entlüftungsöffnung (152, 154) oder mehrere davon aufweist, entweder in einem hohlen Aufhängungsmittel (122, 124) und/oder in einer nahe bei den Aufhängungsmitteln gelegenen Ecke, wobei das Fließen der Luft durch die Öffnungen durch ein Einwegventilgerät kontrolliert wird. 50
10. Einlage wie in den Patentansprüchen 8 oder 9 beansprucht, in welcher das Einwegventilgerät durch die Wände der hohlen Aufhängungsmittel (122, 124) geliefert wird. 55
11. Einlage wie in irgendeinem der Patentansprüche 8 oder 9 beansprucht, in welcher die oder jede Entlüf-

tung und/oder Entlüftungsöffnung durch ein "Labyrinth" Abdichtungsmittel kontrolliert wird, welches Linien von Versiegelungen (156, 158; 160, 162) umfaßt um einen Labyrinthpfad zu bilden.

12. Behälter mit einer Einlage so wie sie in einem jeden der vorangegangenen sich auf dieselben beziehenden Patentansprüche beansprucht worden ist.
13. Behälter wie in Patentanspruch 12 beansprucht, in welchem die Einlage von einer solchen Größe und Form ist und die Aufhängungsmittel mit dem Behälter in solch einer Ausrichtung verbunden sind, daß die Einlage im Verlaufe des Füllens sich den inneren Dimensionen des Behälters anpaßt.
14. Behälter mit einem Einlauf an einem Ende desselben sowie eine Einlage in demselben, dadurch gekennzeichnet, daß in der Einlage mindestens eine Entlüftungsöffnung vorgesehen ist, bei oder in der Nähe des Einlaufendes, und daß dieselbe zwischen den sich gegenüberliegenden Wänden der Einlage mindestens zwei längliche, unterbrochene, benachbarte Versiegelungen (156, 158; 160, 162) besitzt, welche sich in der Nachbarschaft der Entlüftung oder einer jeden davon auf der Seite welche bei der Benutzung mit dem Schüttgut gefüllt wird, befindet, wobei sich die Versiegelungen die eine mit der anderen axial überlappen, um einen Labyrinthpfad zwischen dem Inneren der Einlage und der (den) Entlüftung (en) zu liefern.

#### Revendications

1. Doublure (100) de matière plastique pour un conteneur (140) tel qu'un conteneur en vrac intermédiaire flexible, la doublure comprenant au moins un moyen de suspension (122, 124) pour relier la doublure au conteneur selon une orientation prédéterminée, caractérisée en ce que les moyens de suspension (122, 124) forment un évent pour expulser l'air de la doublure.
2. Doublure selon la revendication 1, dans laquelle le ou chaque moyen de suspension (122, 124) est formé d'une pièce avec la doublure.
3. Doublure selon la revendication 1 ou 2, dans laquelle le ou chaque moyen de suspension (122, 124) se présente sous la forme d'une bande tubulaire de matière.
4. Doublure selon la revendication 3, dans laquelle un ou plusieurs orifices d'évacuation (152) sont aménagés dans une paroi de la bande flexible creuse.
5. Doublure selon l'une quelconque des revendications précédentes, dans laquelle, avant remplissage, la

doublure a une configuration sensiblement exempte d'air.

pour former un trajet labyrinthique entre l'intérieur de la doublure et le ou les événements.

6. Doublure selon la revendication 5, dans laquelle la doublure est pliée pour former un paquet sensiblement exempt d'air, le paquet étant prêt à être relié à un conteneur. 5
7. Doublure selon l'une quelconque des revendications précédentes, dans laquelle le ou chaque moyen de suspension (122, 124) est pourvu de moyens de fixation pour relier la doublure à un conteneur flexible. 10
8. Doublure selon l'une quelconque des revendications précédentes, dans laquelle un dispositif à valve une voie est prévu pour le ou les événements. 15
9. Doublure selon l'une quelconque des revendications précédentes, ayant une ou plusieurs ouvertures d'évacuation (152, 154) dans des moyens de suspension creux (122, 124) et/ou dans un coin voisin des moyens de suspension, l'écoulement d'air à travers les ouvertures étant contrôlé par un dispositif à valve une voie. 20  
25
10. Doublure selon la revendication 8 ou 9, dans laquelle le dispositif à valve une voie est formé par les parois des moyens de suspension creux (122, 124). 30
11. Doublure selon l'une quelconque des revendications 8 et 9, dans laquelle le ou chaque événement et/ou ouverture d'évacuation est contrôlé(e) par un dispositif d'étanchéité "labyrinthique", comprenant des lignes de joints d'étanchéité (156, 158; 160, 162) se chevauchant pour former un trajet labyrinthique. 35
12. Conteneur ayant une doublure selon l'une quelconque des revendications précédentes, qui lui est reliée. 40
13. Conteneur selon la revendication 12, dans lequel la doublure a une taille et une forme telles et les moyens de suspension sont reliés au conteneur dans une orientation telle que la doublure, lors du remplissage, soit conforme aux dimensions internes du conteneur. 45
14. Conteneur ayant une entrée à sa première extrémité et une doublure disposée à l'intérieur, caractérisé en ce qu'au moins une ouverture d'évacuation est aménagée dans la doublure à l'extrémité d'entrée ou au voisinage de celle-ci et ayant au moins deux joints d'étanchéité voisins interrompus allongés (156, 158; 160, 162) entre les parois opposées de la doublure, au voisinage du ou de chaque événement sur le côté qui, en service, est rempli de matière en vrac, les joints d'étanchéité se chevauchant axialement l'un l'autre 50  
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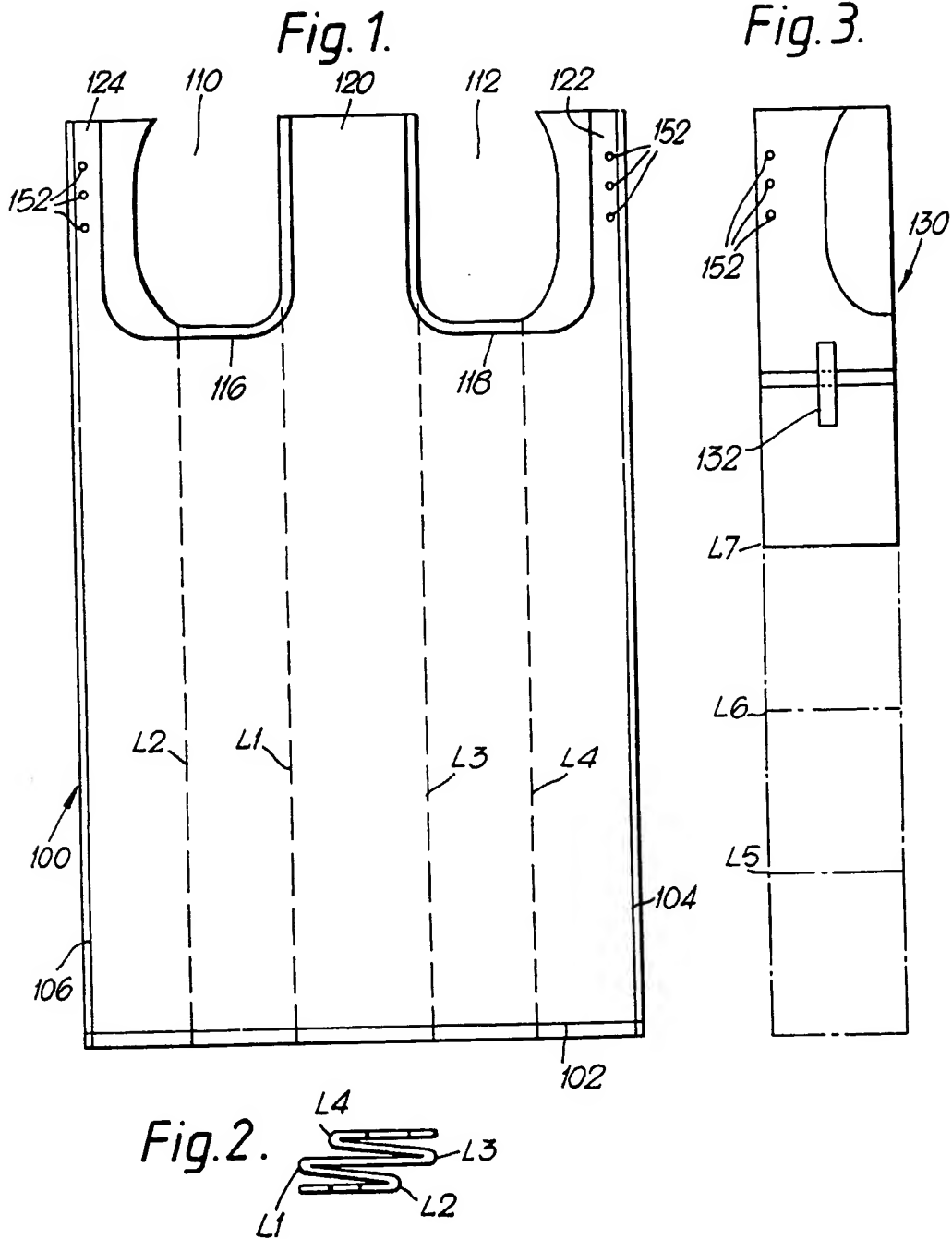




Fig.4.

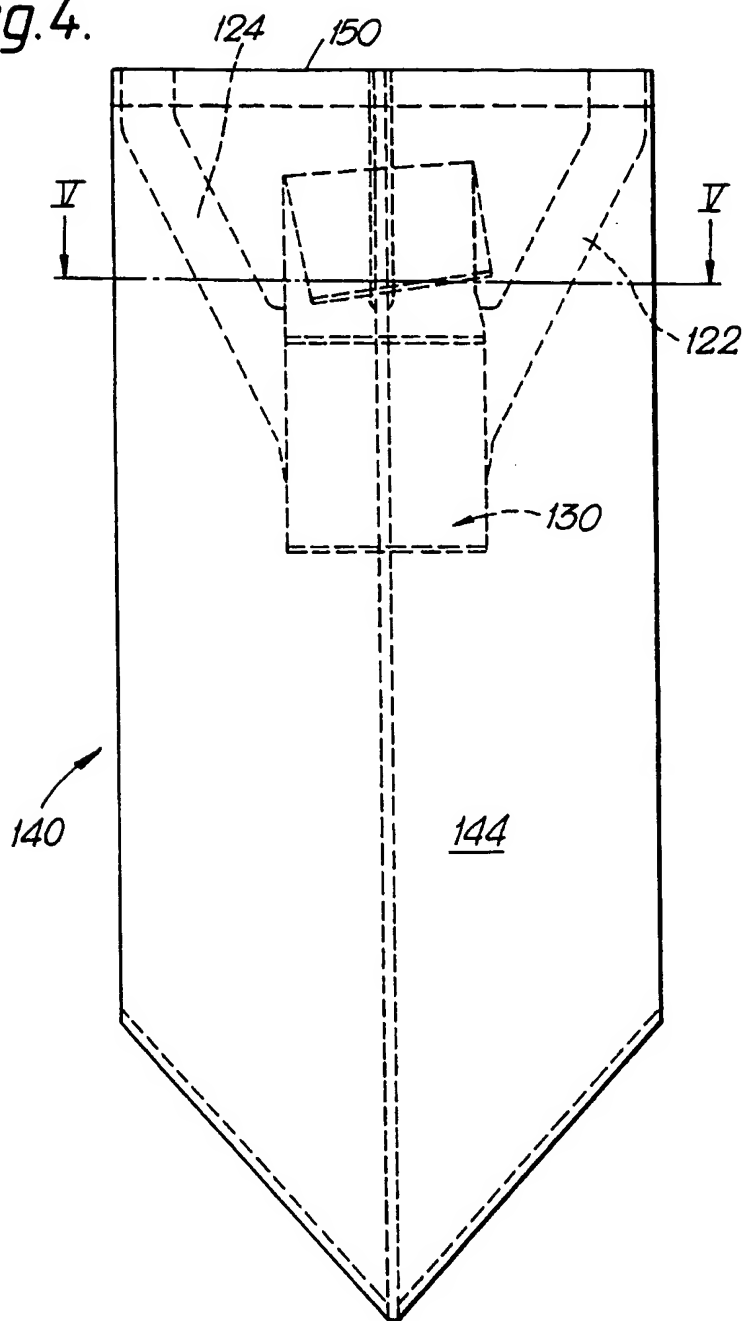


Fig.5.

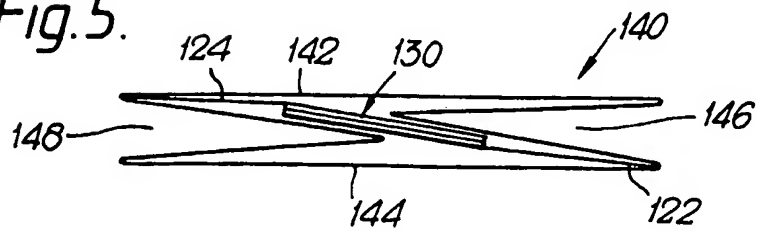


Fig. 6.

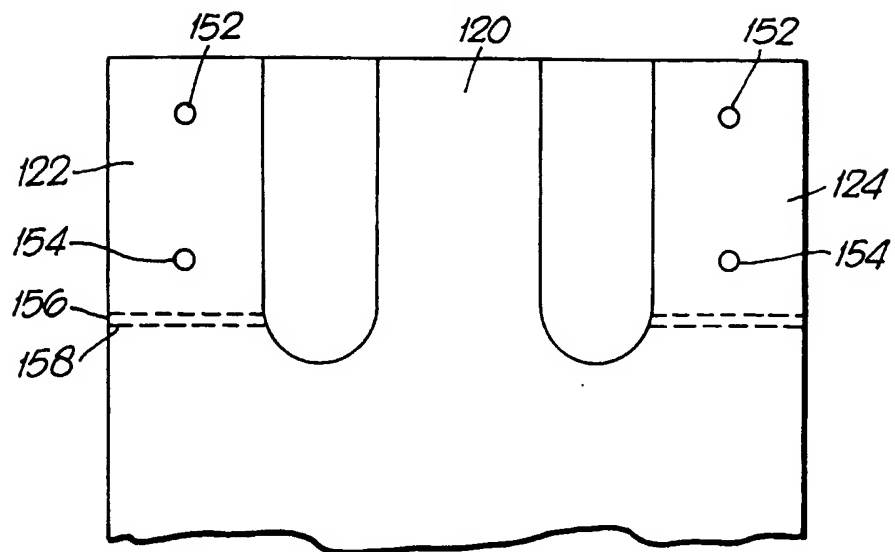


Fig. 7.

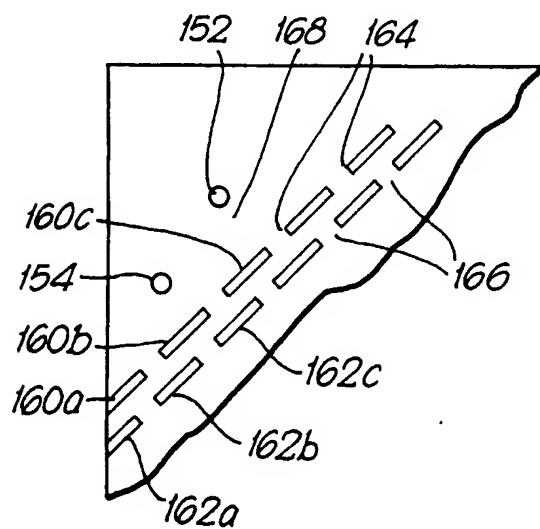


Fig. 8.

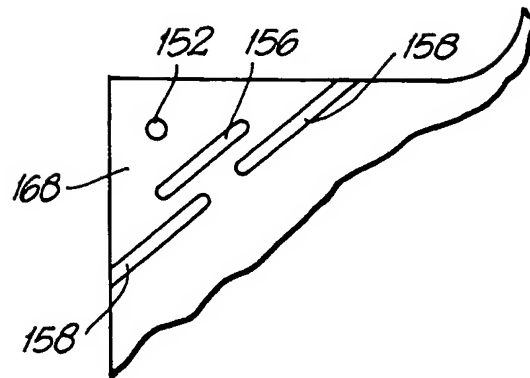


Fig. 9.

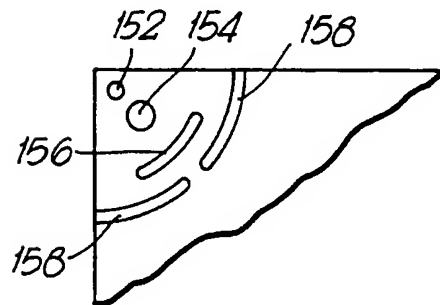


Fig. 10.

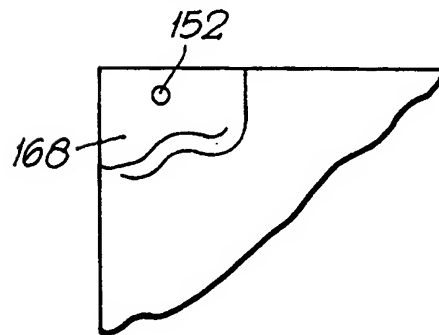


Fig. 11.

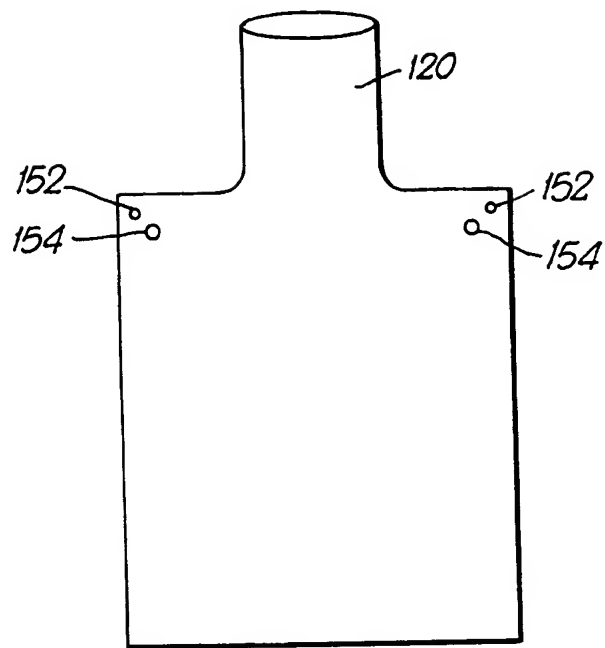


Fig. 12.

